

THE ORIENTAL MOTH (*CNIDOCAMPA FLAVESCENS* WALK.) AND ITS CONTROL¹

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INTRODUCTION AND SPREAD

In February 1906 some peculiar cocoons were found on several kinds of fruit trees in the Dorchester section of Boston, Mass. These were later identified as belonging to a moth, *Cnidocampa flavescens* (Walk.) (fig. 1), which up to that time was known to occur only in the Orient, eastern Siberia, China, Chosen (Korea), and Japan. Since 1906 the insect has attacked certain shade and fruit trees in Boston and vicinity, and because it is apparently a native of the Orient it has become known in its new home as the oriental moth.

Records indicate that the oriental moth may have become established in Dorchester through importations of nursery stock from Japan, as a nursery that handled such material was located near the center of the area found infested in 1906. If the pest became established in this way, it was in all probability before 1902, when the State of Massachusetts began official inspection of nurseries. It is said that before 1909 the insect was found on imported nursery stock at other points in the United States, and there is at least one record of its carriage from Dorchester to a point outside New England. Since the enactment of the plant quarantine law by Congress in 1912 there has been little possibility of its entry on plants imported from foreign countries. The cocoon is the only form of the oriental moth one would expect to find on such material, and, since these cocoons are so conspicuous, it is improbable that they would escape the attention of inspectors.

NOTE.—This species, which confines its attack to the foliage of fruit and shade trees, is not to be confused with the more widely known oriental fruit moth (*Grapholitha molesta* Busck), a pest which tunnels in the twigs of fruit trees and attacks the fruits.

¹ This circular is based on data obtained by several workers over a period of years at the U.S. Bureau of Entomology Laboratory, Melrose Highlands, Mass., and the writer wishes to acknowledge special assistance from T. H. Jones, J. V. Schaffner, Jr., C. E. Hood, W. F. Sellers, and others. Distribution records were furnished by R. H. Allen, of the Massachusetts Department of Agriculture.

How many times the oriental moth may have entered the various States is, of course, uncertain, but so far as is known it has never become established outside of Boston and neighboring cities and towns.

In 1906, the area infested by the oriental moth in Dorchester was found to cover approximately 1 square mile. In 1932 its known distribution extended to Salem on the northeast, a distance of 14 miles; to Arlington and Watertown on the west, a distance of 6½ and 7 miles, respectively; and to Quincy on the southeast, a distance of 8½ miles. Dispersion from the original colony site has been slow, the moth having advanced only 14 miles to the northeast in 26 years.

SEASONAL HISTORY

In Boston and its vicinity a year is required for the oriental moth to complete its life cycle, and during this time it passes through egg, larval, pupal, and adult stages. In Japan, and perhaps elsewhere

in the Orient, some individuals develop so rapidly that they give rise to two generations within a season.

The following summary of the seasonal history of the moth is based on observations made in Boston and vicinity: The adults, or moths (fig. 1), issue over a period of

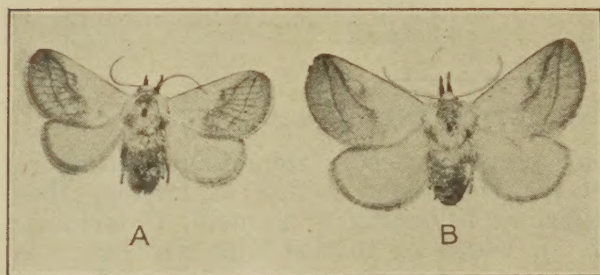


FIGURE 1.—The oriental moth. (*Cnidocampa flavescens*): A, Male; B, female. Natural size.

about a month, from the latter part of June to the latter part of July. The eggs (fig. 2) hatch in about a week. In certain parts of the infested area some of the larvae from these eggs may become fully grown and spin their cocoons early in August, whereas at other points a few may not reach this stage of development until the first of October. This is in part because, as already mentioned, the moths issue and lay their eggs over a period of about a month, and in part may be attributed to local climatic conditions, even in such a limited area as that now infested. The larvae within the cocoons transform to pupae about the first of May.

APPEARANCE AND HABITS

The adult oriental moth is active only at night. During the day it rests in a rather grotesque position. Grasping some object, such as the edge or petiole of a leaf, by its middle or hind feet, the moth lets itself hang downward with the margins of its closed wings in contact with another object. The moth remains in this position until darkness comes, then takes to wing. Its flight is speedy, owing to the very rapid movements of its wings.

In both male and female moths (fig. 1, A, B), the thorax and inner-portion of the wings above are light yellow and the other portions of the body and wings are light reddish brown. Two lines that pass from near the apex of the forewing backward across it are of a darker brown, as are also the fringes of the fore and hind wings. The moths measure from 1¼ to 1½ inches from tip to tip of expanded wings.

The female lays its eggs on the undersides of leaves (fig. 2, *a*), usually singly. The eggs are oval, flattened, about one sixteenth inch in length, with one side in contact with the leaf, and colorless until the developing embryos within become evident through the transparent walls. In confinement, a moth has laid as many as 551 eggs, and dissections of other females indicate that some may lay nearly 1,000 eggs.

When the white, semitransparent larva (fig. 2, *b*) issues from the egg, through an opening that it makes in the shell, it is slightly less than one sixteenth inch long. It molts once before beginning to feed, and later, as it increases in size, it casts its skin 5 or 6 times more before becoming fully grown. With each succeeding molt the larva takes on a greater variety of colors, and when mature it presents a very striking appearance, with markings of yellow, blue, green, and purple. These markings include a purple area on the upper surface, shaped somewhat like a dumbbell.

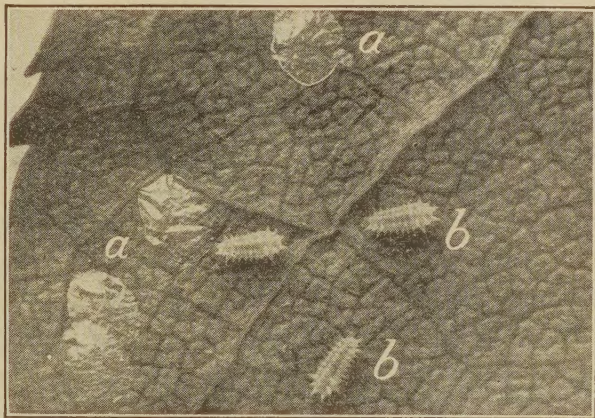


FIGURE 2.—Stages of the oriental moth on leaf: *a*, Eggshells; *b*, newly hatched larvae $\times 7$.

At first the larva eats only small patches of green tissue from the undersurface of the leaf (fig. 3), leaving the upper surface intact; but as it gets older it eats the whole leaf, except the large veins. Its method of moving about resembles that of the garden slug (*Agriolimax agrestis* L.), but in appearance it is very different from the slug, because of its color and the spiny horns on its back. When the larva is disturbed, it has the habit of raising its anterior and posterior extremities and if, when it does this, the spiny horns come in contact with a person's skin, local poisoning or irritation is likely to result, the intensity of the irritation depending on the sensitiveness of the part of the skin touched by the spines and upon the individual's susceptibility to such poisoning.

When fully grown the larva is about seven eighths inch in length (fig. 4, *a*). It now ceases feeding and moves from the leaf to some point on the bark of the tree, usually a fork or crotch of a twig or branch, where it forms its cocoon. The cocoon (fig. 4, *b*) is elliptical, smooth, and hard, with one side firmly attached to the bark. It is grayish brown, usually with peculiar white markings, and resembles a small bird's egg.

In constructing the cocoon the larva first spins a loose network of threads around itself and attaches them to the bark. Within this network it continues to spin its silken thread, gradually weaving the cocoon by moving its head from side to side along the lines of a figure 8. As the threads come close together the larva apparently secretes from its mouth a liquid which fills the spaces between the threads and hardens, producing the hard, dense wall of the cocoon.

By the time the cocoon is completed the appearance of the larva within has changed considerably. It has lost its brilliant coloring and has become a flabby, helpless, yellowish mass. It passes the winter in this condition, and in the spring it once more sheds its skin and then pupates. Later the moth issues from the pupal cocoon by forcing off a circular lid or cap at the upper end.

In Massachusetts the foliage of Norway maple (*Acer platanoides* L.), sycamore maple (*A. pseudoplatanus* L.), buckthorn (*Rhamnus* spp.), black birch (*Betula nigra* L.), wild and cultivated cherry

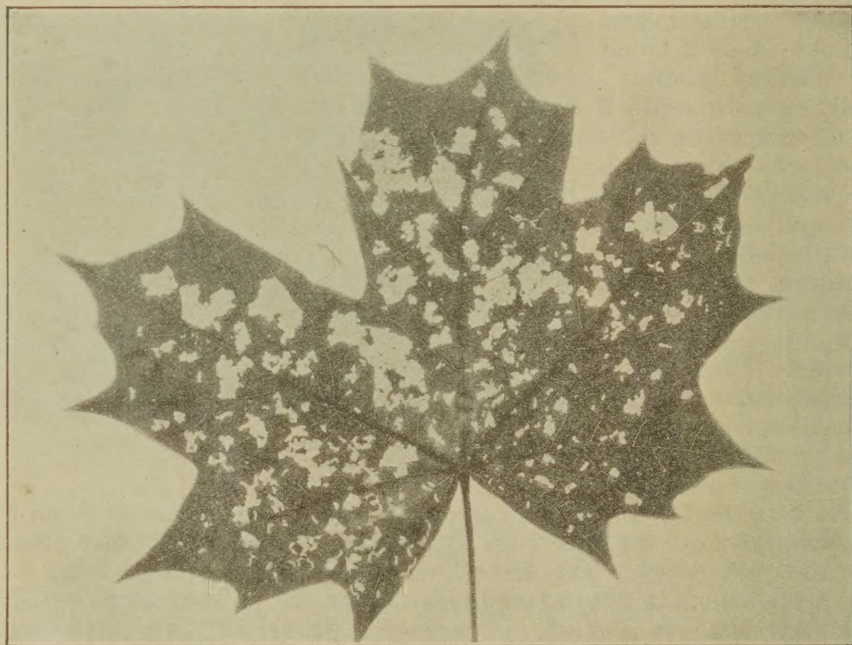


FIGURE 3.—Leaf of Norway maple partly skeletonized from the feeding of young larvae of the oriental moth. Slightly reduced.

FOOD PLANTS

(*Prunus* spp.), apple (*Malus* spp.), pear (*Pyrus* spp.), and plum (*Prunus* spp.) is most commonly and severely injured by the larvae of the oriental moth (figs. 5 and 6). The foliage of several other trees is, however, fed upon, particularly when the insect is abundant. Among these less-favored food plants are other maples (*Acer* spp.), oak (*Quercus* spp.), poplar (*Populus* spp.), willow (*Salix* spp.), honeylocust (*Gleditsia triacanthos* L.), hickory (*Hicoria* spp.), and hackberry (*Celtis* spp.).

There may, of course, be other trees, not represented in the infested territory but growing elsewhere in the United States, that the oriental moth will attack. In Japan it is said to be particularly abundant in certain pear-growing sections; in other sections it is a common pest of persimmon (*Diospyros* spp.) and is sometimes numerous upon plum.

NATURAL ENEMIES

Since becoming established in Massachusetts the oriental moth has never been attacked to an appreciable extent by any native para-

sitic insect. Numerous broken cocoons have sometimes been noted, but the larvae or pupae within them had apparently been destroyed by some predator, perhaps by birds or squirrels. Certain parasitic insects are known to attack the pest in the Orient, and in 1917 and 1918 H. T. Fernald, then professor of entomology at Massachusetts Agricultural College, obtained shipments of one of these, *Chrysis shanghaiensis* Walk., from China. Adults of this beneficial wasp were liberated in Boston but the attempt to establish it was unsuccessful.

During 1929 and 1930 the Bureau of Entomology liberated, at 16 points in Boston and vicinity, approximately 85,000 adults of a parasite imported from Japan. This parasitic fly, *Chaetoxorista javana* B.B. (fig. 7), lays its egg on the larva of the oriental moth. The maggot that issues from the egg bores into the body of the larva, where it feeds and forms its pupal case (fig. 8, B). The host is killed after making its cocoon (fig. 8, A).

The results obtained from liberating this fly have been very encouraging. Examinations of cocoons collected in the field in the years since the first flies of *Chaetoxorista javana* were put out have shown that the parasite has not only established itself and spread to a distance of at least 6 miles from the nearest liberation point but has become an important factor in reducing the population of the oriental moth. The extent to which *C. javana* has multiplied and increased in effectiveness is shown by the fact that only 0.78



FIGURE 4.—The oriental moth: a, Large larvae and results of their feeding; b, cocoons on twig. Natural size.

percent of the larvae in 764 cocoons, collected at two points in 1930, the year after the first flies were liberated, were parasitized, whereas the following year (1931) 1,901 cocoons were collected from points where flies had been put out either 1 or 2 years before, and 8.57 percent contained parasitized larvae. Collections made a year later,

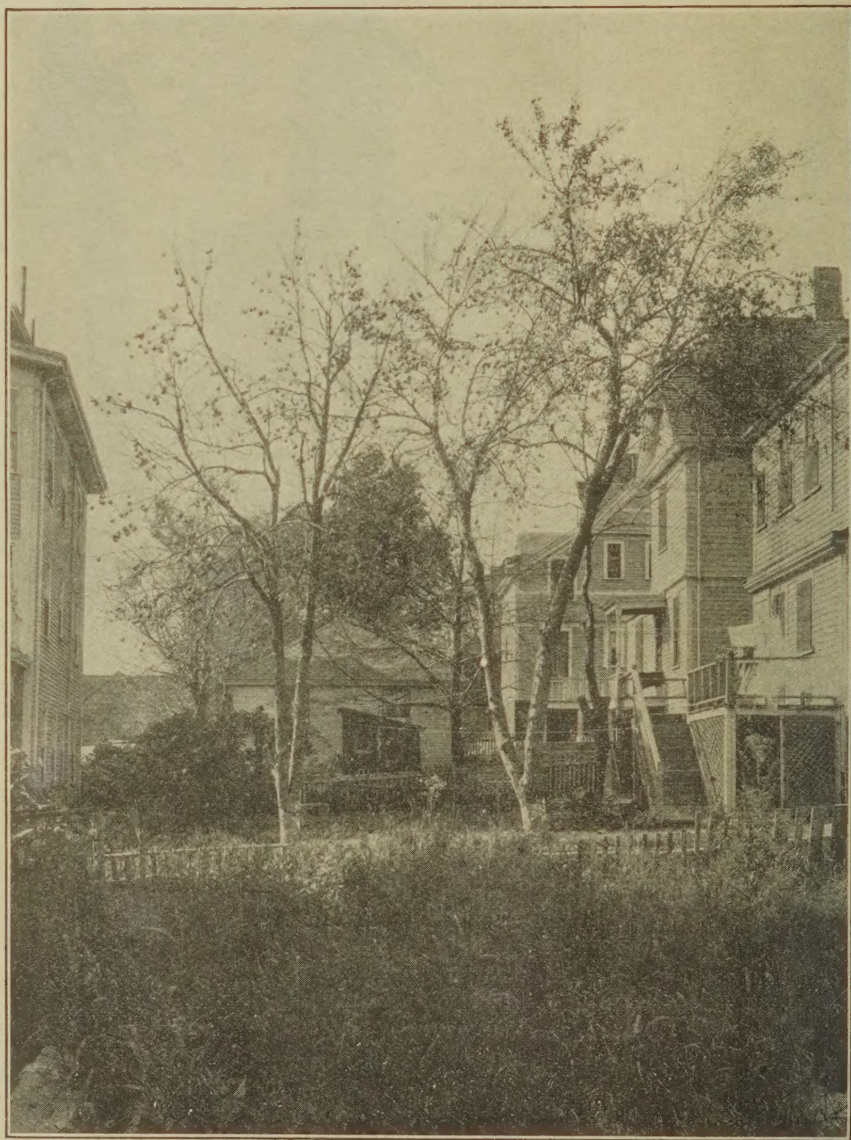


FIGURE 5.—Pear trees (in foreground) and cherry tree (in background) defoliated by the oriental moth.

during the winter of 1931-32, and totaling 2,498 cocoons, gave a percentage of parasitization of 16.49; and the following winter (1932-33), of 2,235 cocoons collected, 52.43 percent contained parasitized larvae.

CONTROL

Field and laboratory experiments conducted in 1932 indicate that the larvae of the oriental moth can be controlled satisfactorily by

spraying with lead arsenate, 3 pounds to 100 gallons of water, with the addition of fish oil or linseed oil, as an adhesive, in the proportion of 4 ounces, or one fourth pint, to each pound of lead arsenate used. This strength of the poison is sufficient to kill the larvae in the early instars which occur about August 1 to 15 at Boston, Mass., and vicinity. After the first of the larvae become half grown (about August 15, or later) the concentration should be increased to 4 pounds to 100 gallons of water, with the addition of fish oil or linseed oil in the proportion stated above.

If the spraying is to be done on trees very close to houses or fences, where it is impracticable to use fish oil or linseed oil as an

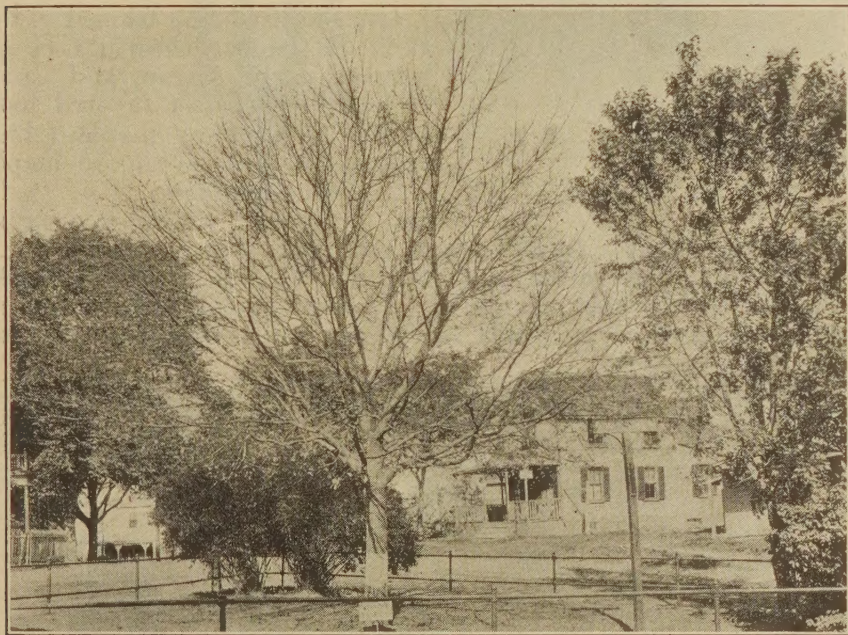


FIGURE 6.—Norway maple defoliated by the oriental moth. The silver, or cut-leaved, maple nearby does not show injury.

adhesive, 1 pound more of lead arsenate should be used in each of the above sprays. For best results spraying should not be delayed later than 2 weeks before the first larvae will become fully grown and begin spinning their cocoons.

If the cocoons appear in small numbers and in low growth, they can be crushed or hand picked and destroyed.

SUMMARY

The oriental moth was first found in the vicinity of Boston, Mass., in 1906, the result of an unwelcome introduction with plants imported from the Orient. It has spread slowly from the original point, advancing only 14 miles—the greatest known distance, to the northeast—in 26 years. It has only one generation annually in this country. The adults measure $1\frac{1}{4}$ to $1\frac{1}{2}$ inches from tip to tip of expanded wings. They are light yellow on the thorax and inner portion of the wings, while other portions of the body and wings

are light reddish brown. The moths are active from the latter part of June until the latter part of July. The young larvae begin to appear during the early part of July but the last of them do not complete their growth until the first of October (Boston, Mass., and vicinity). With each succeeding molt, the larva takes on more variety of color, hence when approaching maturity it has markings of yellow, blue, green, and purple.



FIGURE 7.—*Chaetexorista javana*, a parasite of the oriental moth. Adult, $\times 2$.

(*Prunus* spp.), apple (*Malus* spp.), and pear (*Pyrus* spp.).

As a result of liberating, in 1929 and 1930, approximately 85,000 adults of *Chaetexorista javana* B.B., a tachinid parasite from Japan, this parasite has become firmly established and is exerting much influence toward control, as evidenced by a gain in average parasitization from 0.78 percent in 1930 to 52.43 percent in 1932-33. This control was further observed in a decided decrease in the number of host cocoons present during the latter year.

The oriental moth can also be controlled in the early larval instars (August 1-15) by spraying with lead arsenate at the rate of 3 pounds to 100 gallons of water with the addition of fish oil or linseed oil, as an adhesive, in the proportion of 4 ounces, or one fourth pint, to each pound of lead arsenate used. After August 15, when the larvae are one half or more grown, an additional pound of poison should be added with a proportional increase of sticker.

Cocoons are being formed in the axils of the branches and twigs between early August and early October. The most favored food plants are Norway maple (*Acer platanoides* L.), sycamore maple (*A. pseudoplatanus* L.), wild and cultivated cherry and plum

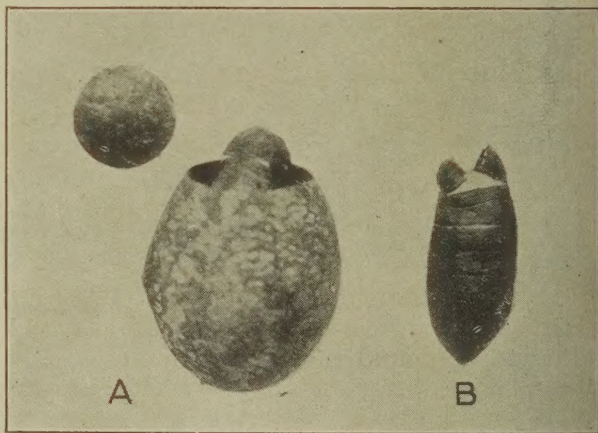


FIGURE 8.—A, Cocoon and detached cap of the oriental moth, showing pupal case of *Chaetexorista javana*; B, pupal case of *C. javana* removed from the host cocoon. $\times 2$.